a. amending claim 1 to recite "nanometers squared" or "square micrometers," in order to conform the recitation of nano- or micrometers to the recitation of "an area";

b. amending claim 1 to change "a material" (second instance) to –the material– in order to correct an antecedence error;

c. amending claim 1 to recite –a temperature– of the material for antecedence purposes;

d. amending claim 1 to delete the term "growth," which is said to contradict recitations of etching or cleaning;

e. amending claim 4 to clarify that the generally parallel direction is the direction in which the electrons are transmitted;

f. amending claim 8 to delete the relative term "fast";

g. amending claims 10 and 13 for antecedence purposes;

h. amending claims 14 and 15 to refer back to the material recited in claim 1; and

i. amending claims 14 and 15 by deleting "to permit recycling" since this phrase is given no weight by the Examiner

In addition, it is respectfully noted that claim 1 has been amended to limit the claims to propagation of shockwaves (or essentially equivalent "thermal spikes") in a cryogenic medium. The purpose of the amendment is to simplify the issues involved in this response, and not because the Applicant agrees that controlled nano-scale propagation of shockwaves is disclosed or suggested by the prior art discussed below. Applicant reserves the right to file a divisional or continuation application directed to non-cryogenic embodiments of the invention.

3. Rejection of Claims 1-16 Under 35 USC §102(f) ("Discrepancy" Between Inventors of U.S. and PCT Application)

The PCT application lists Sveinn Olafsson as "applicant" and inventor, and Kenney as "applicant." In PCT cases, the "applicants" may be inventors or assignees, not just inventors, and

Mr. Kenney is listed solely as an applicant, and not an inventor. As a result, there is no "discrepancy" of the type noted in item 9 on page 6 of the Official Action.

Mr. Olafsson is indeed the sole "inventor" of the claimed subject matter, as is correctly stated in the PCT publication, and therefore withdrawal of the rejection of claims 1-16 under 35 USC §102(f) is respectfully requested.

4. Rejections of Claims 1-3, 5, and 8-12 Under 35 USC §102(b) in view of U.S. Patent No. 5,043,578 (Guethner), and of Claims 4 and 14-15 Under 35 USC §103(a) in view of the Guethner patent

This rejection is respectfully traversed on the grounds that the Guethner patent fails to disclose or suggest processing a material by a controlled succession of nanometer scale thermal spikes or shockwaves of varying energy, much less processing the material by controlled propagation of thermal spikes or shockwaves of varying energy in a cryogenic medium, as is now recited in claim 1 (and previously recited in claim 6). Instead, Guethner discloses a system in which atoms to be deposited on a surface are emitted by the tip of a probe and transferred directly to the surface.

Even assuming that the current emitted by the probe produces thermal spikes, the thermal spikes are clearly not controlled to have varying energy. If the energy of the atoms being transferred were varied, it would be very difficult to use a current-based distance servo, such as servo control means 18 of Guethner, to control probe-to-surface distance, since a current-based distance servo assumes that the current varies solely as result of distance variations so that other factors do not have to be factored into the distance calculation.

In addition, Guethner's direct deposition of atoms onto a surface does not appear to require any sort of "medium," much less a cryogenic medium. While shockwaves and thermal spikes of the type claimed require a medium in order to propagate, atoms can travel through a vacuum solely in response to charge differences between the workpiece and emitter electrode, without propagating in a medium. Even if a "medium" of some type were used by Guethner,

Guethner effectively ***teaches away*** from a ***cryogenic*** medium since the method of Guethner is intended to be "**effected at ambient temperature and pressure**" (col. 1, lines 64-68).

The Examiner will note that the present invention does not concern direct transfer of deposited **materials** from a probe tip to the workpiece. Instead, it concerns transfer of **energy** to the workpiece to enhance chemical processes such as vapor deposition or etching. In fact, in one embodiment, the electrodes are situated so that the electron beam extends parallel to the surface of the workpiece, so that no materials, including electrons, are transferred from the probe tip to the work surface. Instead, only "thermal spikes" or shockwaves are transferred in the parallel electron beam embodiment (shockwaves being essentially equivalent in this context to thermal spikes).

Since the goal is to transfer energy as efficiently as possible, it seems counterintuitive to aim the electron beam away from the medium, and to use a cryogenic medium. However, the inventor has found that by effectively converting the energy of the electrons into physical shockwaves that propagate through the cryogenic medium, and at the same time avoiding a steady state or oscillating field, the shockwaves will transfer virtually all of the energy to the workpiece with minimal losses in the medium. This concept is not even remotely suggested by Guethner.

The Examiner has amply demonstrated that the use of probe tips to transfer deposition materials to a workpiece is well known. However, the invention has nothing to do with transfer of deposition materials from a probe tip. Instead, it involves generation of thermal spikes or shockwaves, and more specifically the novel concepts of varying the energy of the thermal spikes or shockwaves and of propagating the spikes or shockwaves in a cryogenic medium.

Because Guethner discloses or suggests none of these concepts, withdrawal of the rejections of claims 1-5, 8-12, 14, and 15 under 35 USC §§102(b) and 103(a) in view of the Guethner patent is respectfully requested.

5. Rejection of Claim 16 Under 35 USC §103(a) in view of U.S. Patent Nos. 5,043,578 (Guethner) and 5,015,323 (Gallagher)

This rejection is respectfully traversed on the grounds that the Gallagher patent, like the Guethner patent, fails to disclose or suggest processing a material by generating a controlled succession of nanometer scale thermal spikes of varying energy, much less processing the material by thermal spikes of varying energy that propagate in a cryogenic medium, as recited in claim 1, from which claim 16 depends. Instead, the Gallagher patent, like the Guethner patent, in which atoms to be deposited on a surface are transferred directly from the tip of the probe to the workpiece surface.

It is true that the system of Gallagher varies the energy of the materials being deposited, but only once upon detecting a deposition-induced charge current, which hardly constitutes a controlled succession of thermal spikes of varying energy, as claimed. While atoms being directly deposited from a probe tip might carry thermal energy, they do not correspond to the claimed thermal spikes or shockwaves propagating in a medium, which are pure energy. Of course, the embodiment of the present invention in which the electrodes are parallel to the workpiece could not possibly be suggested by Gallagher, whose purpose is to more efficiently deliver materials from the probe tip to the workpiece.

Furthermore, although the materials are deposited in the system of Gallagher through a CVD gas, which constitutes a "medium," the gases disclosed are not cryogenic gases. To the contrary, the substrate is optionally heated to temperatures of 100-200°C, and the lowest temperature disclosed is "room temperature" (col. 16, lines 19-27 and 50-52).

Because neither Guethner nor Gallagher discloses or suggests processing a material by transferring thermal spikes or shockwaves of varying energy that propagate in a cryogenic medium, withdrawal of the rejections of claims 1-5, 8-12, 14, and 15 under 35 USC §§102(b) and 103(a) in view of the Guethner patent is respectfully requested.

6. Rejections of Claims 1-3, 6, and 12 Under 35 USC §102(b) in view of U.S. Patent No. 5,038,322 (Van Loenen), and of Claims 4, 5, and 9 Under 35 USC §103(a) in view of the Van Loenen patent

This rejection is respectfully traversed on the grounds that the Van Loenen patent also fails to disclose or suggest processing a material by a controlled succession of nanometer scale thermal spikes of varying energy in a cryogenic medium, as recited in claim 1 (although the apparatus of Van Loenen may optionally be cryogenically cooled, as discussed below). Instead, in Van Loenen, a feedback controlled constant tunneling current is used to dig a pit and then the tip is lowered into the material to be processed. At the time that energy in the form of the electron beam is being transferred, the tunneling current serves as an input to a distance servo, and therefore can only vary with distance. When the voltage is varied, the purpose is essentially to guide the tip into the pit dug by the tunneling current.

It is true that the Van Loenen patent discloses cryogenic cooling. However, Van Loenen merely discloses that the vacuum chamber in which the process is performed may, optionally, be maintained at a low temperature by means of a "cryogenic cooler," as described in col. 6, lines 28-35. This is not the same as, or suggestive of, use of a cryogenic medium, as claimed. Instead, the cooling of Van Loenen is to facilitate operation of the scanning electron microscope, and not for reasons related specifically to the etching process with which the Van Loenen patent is concerned. There is no disclosure in Van Loenen of a cryogenic medium, much less the controlled propagation of thermal spikes or shockwaves through the medium in the manner claimed.

Since the Van Loenen patent does not suggest the claimed propagation of thermal spikes or shockwaves in a medium, and certainly does not suggest propagation in a cryogenic medium for the purpose of efficiently transferring energy to a nano-scale area of the workpiece so as to facilitate the occurrence of chemical processes in the local area, withdrawal of the rejections of claims 1-6, 9, and 12 based on the Van Loenen patent is respectfully requested.

7. Rejection of Claim 13 Under 35 USC §103(a) in view of U.S. Patent Nos. 5,043,578 (Van Loenen) and 5,352, 330 (Wallace)

This rejection is respectfully traversed on the grounds that the Wallace patent, like the Van Loenen patent, fails to disclose or suggest processing a material by generating a controlled succession of nanometer scale thermal spikes of varying energy, much less processing the material by thermal spikes of varying energy that propagate in a cryogenic medium, as recited in claim 1, from which claim 13 depends.

Instead, the Wallace patent discloses use of a low energy electron beam (as opposed to a conventional light beam) to remove surface passivation through an electron stimulated desorption effect. This effect requires that the electrons interact with atomic bonds between hydrogen and silicon to repel silicon atoms from the surface of the material. Thermal spikes or shockwaves are not utilized (assuming that "low energy" electrons would even generate such shockwaves), and no attempt is made to vary the energy of the thermal spikes or shockwaves. The process does not use a medium during the desorption, although oxygen is added later, and there is no suggestion of carrying out the process at cryogenic temperatures.

It is respectfully submitted that since carrying out a process at cryogenic temperatures is more difficult than carrying out a process at room temperature, one of ordinary skill in the art would not have done so in the absence of a teaching that the specific process in question would benefit from being carried out in the presence of a cryogenic medium. Accordingly, it is respectfully submitted that the Van Loenen and Wallace patents could not have suggested the claimed invention, whether considered individually or in any reasonable combination, and withdrawal of the rejection of claim 13 under 35 USC §103(a) is respectfully requested.

8. Rejection of Claims 1-4 and 12-13 Under 35 USC §§102(b) and 103(a) in view of U.S. Patent No. 4,896,044 (Li)

This rejection is respectfully traversed on the grounds that the Li patent, like the Van Loenen and Guethner patents, fails to disclose or suggest processing a material by generating a controlled succession of nanometer scale thermal spikes of varying energy, much less processing

the material by thermal spikes of varying energy that propagate in a cryogenic medium, as recited in claim 1. Instead, the Li patent discloses use of an electron beam to accomplish etching of a substrate by vaporization.

It is noted, furthermore, that the Li system is disclosed as an **alternative** to use of chemical etchants, and therefore is exactly contrary to the claimed use of etch gases. Whereas the claimed invention involves the use of thermal spikes or shockwaves, which have no etchant capabilities on their own, to enhance etching by the etchants, Li actually uses electrons to vaporize portions of the workpiece. Thus, the Li patent neither anticipates the claimed invention nor renders it obvious.

9. Rejection of Claims 7 Under 35 USC §103(a) in view of U.S. Patent Nos. 5,043,578 (Van Loenen), 3,720,598 (Thompson), and 4,343,993 (Binnig)

This rejection is respectfully traversed on the grounds that while Thompson teaches the use of cryogenic fluids as a medium through which an arc is discharged in a "cryogenic arc furnace," as discussed on pages 3-4 of the present application, there is no suggestion of using such a cryogenic medium in an electron beam etching system of the type disclosed by Van Loenen. The fact that cryogenic media are required in cryogenic blast furnaces is not a teaching that such media would be used in other, non-arc based media processing apparatus. To the contrary, in the absence of a teaching that the electron beam of Van Loenen could be used to propagate thermal spikes or shockwaves in the cryogenic medium (and there is absolutely no use for such spikes or shockwaves in the system of Van Loenen), it cannot be said that the ordinary artisan would have been motivated by Thompson to modify the system of Van Loenen to generate such shockwaves, much less in a controlled succession of thermal spikes or shockwaves of varying energy, as claimed.

The teachings of Binnig, on the other hand, are directly applicable to the system of Van Loenen. In particular, Binnig teaches vacuum operation and cryogenic cooling of a scanning tunneling microscope to improve to suppress thermal fluctuations and thereby improve the

sensitivity of the microscope. However, this merely explains why Van Loenen mentions cryogenic cooling, and is not suggestive o a cryogenic shockwave-propagation medium, as claimed.

The cryogenic cooling of a scanning tunneling microscope, as disclosed by Van Loenen and Binnig, has absolutely nothing to do with the cryogenic medium of the present invention. Van Loenen and Binnig are seeking to minimize disturbances in the scanning electron beam and circuitry by operating the apparatus as cryogenic temperatures **in a vacuum**, so that the electron beam does not have to pass through any medium. As a result, adding a medium of any kind would be contrary to the principles of operation of the Van Loenen and Binning devices, while causing thermal spikes or shockwaves of varying energy would only make the situation worse, rendering it impossible to achieve the desired angstrom scale scanning resolution.

The Examiner is reminded a combination is improper if the teachings of the secondary reference appear to negatively affect the operation of the device disclosed in the primary reference. As explained in **MPEP 2143.02** (page 2100-111):

> *If the proposed modification would render the prior art invention being modified* ***unsatisfactory for its intended purpose****, then there is no suggestion or motivation to make the proposed modification*" (citing *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984)).

It is respectfully submitted that the addition of a medium to a system, such as that of Van Loenen or Binnig, that requires a vacuum is exactly the type of "unsatisfactory" modification referred-to in MPEP 2143.02.

In fact, even if just a *change* in principles of operation is required, the combination is non-obvious unless the teachings specifically address the changing in operating principle. For example, as explained in **MPEP 2143.02**:

> *If the proposed modification or combination of the prior art would* ***change the principle of operation of the prior art invention being modified****, then the teachings of the references are not sufficient to render the claims prima facie obvious* (citing In re Ratti, 270 F.2d 810, 123 USPQ 349 (CCPA 1959)...*The*

> *court reversed the rejection holding the "suggested combination of references would require a* ***substantial reconstruction and redesign*** *of the elements shown in [the primary reference]* ***as well as a change in the basic principle under which the [primary reference] construction was designed to operate"*** *123 USPQ at 352.* (See also, MPEP 2141.02, p. 2100-107 "**A prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention** (emphasis in the original).

It is respectfully submitted that the proposed modifications of the Van Loenen system would certainly change its principle of operation in ways that are not justified by the teachings of Binnig or Thompson.

Because Thompson discloses non-nano-scale cryogenic blast furnace as discussed on pages 2 and 3 of the present application, and Van Loenen considered in view of Binnig effectively teaches away from a cryogenic medium by requiring not only cryogenic cooling, but also a vacuum, it is respectfully submitted that rejection of claim 7 under 35 USC §103 is improper and should be withdrawn.

10. Rejections of Claims 1-5, 8, and 9 Under 35 USC §102(b) in view of U.S. Patent No. 3,663,788 (Inoue)

This rejection is respectfully traversed on the grounds that the Inoue patent fails to disclose or suggest processing a material by a controlled succession of nanometer scale thermal spikes of varying energy, much less processing the material by thermal spikes of varying energy in a cryogenic medium, as is now recited in claim 1 (and previously recited in claim 6).

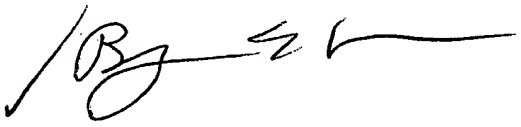
Instead, the Inoue patent discloses a spark discharge system of the type disclosed on page 2 of the specification, which involves spark discharges that are not nanoscale discharges. While the particles carried along by the discharge may be nanoscale, the spark discharge affects numerous such particles, and clearly is macroscopic in size, as is the total area of the material affected. In addition, there is no suggestion in Inoue of using a cryogenic medium for the spark discharge, and it is unlikely that use of a cryogenic medium in the spark discharge system of

Inoue would work. Accordingly, withdrawal of the rejection of claims 1-5, 8, and 9 under 35 USC §102(b) in view of the Inoue patent is respectfully requested.

Having thus overcome each of the rejections made in the Official Action, expedited passage of the application to issue is requested.

Respectfully submitted,

BACON & THOMAS, PLLC



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